

## Critical Analysis Team Report on Silo 3 Constructability Review

15 September 1999

### CAT Report Number 10

The Critical Analysis Team (CAT) attended the Silo 3 constructability review presented by Rocky Mountain Remediation Services (RMRS) on 14 September 1999.

The CAT is surprised that the conceptual design is not completed. The contract was signed six months ago and it is reasonable to believe conceptual design should be further along. The slow design process amounts to using schedule contingency too early in the project life-cycle. This contingency will likely be needed later in the project and shouldn't be squandered now.

The treatment building (uninsulated, impervious membrane walls) will have to be heated and cooled. In addition to process considerations (freezing temperatures), it is unlikely that workers would be productive or highly motivated without facility heating and cooling. An added factor is that because of the nature of the process material (dust prone) workers will probably be required to wear protective clothing and use breathing air.

Adequate consideration of the off-gas and HVAC filtration systems is important. RMRS must understand and adequately plan for prefilter and HEPA filter testing, handling, packaging, containing, storage and replacement. In addition, RMRS should consider installing preheaters on the HEPA filters inlet air streams to prevent freezing during cold and humid weather.

The operation of the remote aspects of the retrieval system is crucial to success. The CAT is not convinced that adequate attention is being focused on this area. For example, the proposed remote arm has never been used, includes potential contamination traps (hinges, etc.), will require significant operator training, and contains hydraulic fluid which could cause problems if mixed with the silo waste. In addition, the physical size of the silo and the potential for waste retrieval to generate large quantities of dust will make viewing of waste retrieval activities difficult. Because of these challenges, FDF and RMRS should identify an alternative (fall-back) technology should use of the arm not prove feasible. Also, RMRS should ensure they have access to a remote expert to assist in remote design, procurement, training, testing and startup (BNFL may already be providing this person(s)) to ensure the arm operates properly.

As the project progresses, both FDF and RMRS must be developing the basis for the Operational Readiness Reviews (ORR). History clearly demonstrates the wisdom of carefully planning and preparation for an ORR including records management, document control and as-building. RMRS should be planning and implementing these activities at the present time.

The current schedule is assumed to be four ten-hour days. Assuming a 70% availability means 7 hours per day of productive work. This is an aggressive assumption. RMRS should evaluate this assumption against FDF productivity factors and experience.

While the concept of quick tear-down and closure of the facility appeals to the CAT, the early facility design does not appear to lend itself to easy or quick D&D.

FDF should be sure RMRS is aware of all of the local conditions, restrictions and requirements that might influence performing work (lift limits due to wind, planning processes before entering contaminated areas, job planning, etc.)

Mock-up and testing of complex process equipment is important. A good example of this is the automated sampling equipment.

### Drawing Comments

- Process Flow Diagrams should identify all relevant input and output streams to each unit operation (including recycle streams) and be related to the mass balance. The sum of inputs and outputs around each unit operation, and the total process should equate.
- Process Flow Diagrams should identify all relevant streams (including recycles) and should be shown on the mass balances.
- Mass balances should...
  - ...show silos materials on a dry basis.
  - ...show percentage moisture of the silo material, conveyance air, and conveyance air on dry mass flow and volume.
  - ...show the pressure and temperature of each stream.
  - ...show estimated particle loadings and distribution in the conveyance and process air exhaust.
  - ...show the basis for the mass balance calculations i.e. lbs/hr silo material (dry basis of X weight percentage water) based on Y hrs./day operation. Also indicate the moisture content of the silo material and the conveying air may vary within certain ranges during operation.
- Removing the large fraction of Silo 3 material that is less than five micron and even submicron in size to protect both the environment and vacuum pumps presents significant challenges. Air cleaning experts with industrial experience should be consulted very early as this issue could significantly impact facility design and operations.
- The pneumatic transport and off-gas treatment systems should operate under a slight vacuum with respect to ambient pressure to prevent contaminating work areas.

- The CAT is pleased that the facility is designed with a sump collection system, floors sloped toward the sump, and a nonporous coating.

#### Summary of Recommendations

RECOMMENDATION 10-1: RMRS should expedite the design process based on this report's comments.

RECOMMENDATION 10-2: RMRS should assume that the process facility will need heating and cooling capability.

RECOMMENDATION 10-3: RMRS should conduct mock-up and testing of any complex process equipment, especially remote equipment.

RECOMMENDATION 10-4: RMRS should ensure that it has a remote and air cleaning expertise available to assist with the project.

RECOMMENDATION 10-5: RMRS should carefully consider the time that could be required to train personnel to operate the remote arm using only TV monitor viewing.

**RESPONSE TO COMMENTS**  
**CRITICAL ANALYSIS TEAM (CAT) REPORT NO. 10**  
**CONSTRUCTABILITY REVIEW**  
**SEPTEMBER 15, 1999**

COMMENT	RESPONSE
<p>1. Expedite design process</p> <p>"... contract was signed six months ago and it is reasonable to believe conceptual design should be further along."</p>	<p>In early November, engineering representatives (John Smets and CAT member Bob Roal), met with RMRS to discuss design issues. The design was reviewed and issues/paths forward identified.</p> <p>November 15-17, an over-the-shoulder review was conducted at RMRS to review the preliminary design progress, design basis documents, and site preparation package. RMRS had incorporated many of the suggestions from the previous meeting with John Smets and Bob Roal. The design is significantly further along than it was in early November. Fluor Fernald feels that with continued emphasis on design, the schedule will be maintained, and the end result will be a quality product.</p>
<p>2. Evaluate process facility heating and cooling capability</p> <p>"... it is unlikely that workers would be productive or highly motivated without facility heating and cooling."</p>	<p>RMRS will evaluate the need for heating and cooling the facility during the design process and the results will be included in the final design package.</p>
<p>3. In addition to temperature, consider workers' use of PPE and breathing air.</p> <p>"... nature of process material (dust prone) workers will probably be required to wear protective clothing and use breathing air."</p>	<p>The design has been changed since the meeting with Fluor Fernald and the CAT; the airborne contamination area has been significantly reduced to allow many more activities to be performed without the use of PPE.</p> <p>Only invasive maintenance will require the use of PPE and breathing air.</p>
<p>4. "... plan for prefilter and HEPA filter testing, handling, packaging, containing, storage, and replacement."</p>	<p>As previously planned in the initial design, prefilter and HEPA filter testing, handling, packaging, containing, storage, and replacement will be evaluated and proceduralized prior to operations.</p>

5. "... consider installing preheaters on HEPA filters inlet air streams to prevent freezing. . ."	RMRS will evaluate the use of preheaters during the design process, per discussions with them.
6. RMRS should conduct mock-up and testing of any complex process equipment, especially remote equipment.	Fluor Fernald and RMRS are working together to pursue this approach. Off-site training capability will be dependent on worker availability and the timing of off-site testing to support construction.
7. RMRS should ensure that it has a remote and air cleaning expert available to assist with the project.	BNFL has retained the services of an HVAC expert. Discussions with this engineer provide a high level of confidence that the appropriate air handling measures will be used for this project. Fluor Fernald will continue to monitor progress and review Flow and Control Diagrams to evaluate the expertise of the HVAC Engineer assigned.
8. "... identify an alternative (fall-back) technology should use of the arm not prove feasible."	<p>The contingencies that are currently being considered consist of end-effectors for the arm rather than an alternative to the arm, such as the use of a scarifier, etc.</p> <p>RMRS remains technically and financially responsible for ensuring safe and successful operation of the retrieval process.</p>
9. "... RMRS should ensure they have access to a remote expert to assist in remote design, procurement, training, testing, and start-up . . . to ensure arm operates properly."	The combined RMRS team has access to resources that have this experience and they will utilize their in-house expertise to develop the remote aspects of this facility. The initial remote requirements may have been underestimated, but they have been recognized at this time. Fluor Fernald will continue to provide detailed review of the concepts to assure that they are practical and implementable.
10. Evaluate time that could be required to train personnel to operate the remote arm using only TV monitor viewing.	Both Fluor Fernald and RMRS Operations Managers are aware of the concern with respect to the remote operation of equipment, such as the retrieval arm and will assure that they are involved in the determination of the training requirements as the design develops. Since the

	<p>equipment is still being developed, continued involvement will assure that operability is continually considered.</p> <p>Both the Fluor Fernald and RMRS Operations Managers have significant experience in operation of remote equipment.</p>
<p>11. RMRS should be implementing ORR planning activities</p> <p>"...FDF and RMRS must be developing the basis for the Operational Readiness Reviews (ORR)."</p>	<p>7/9/99 - Fluor Fernald kick-off meeting with Operations Assurance (OA) and Silo 3 Project team members regarding the ORR Plan of Action (POA). A meeting was also held with the DOE to ensure their early involvement in ORR planning.</p> <p>RMRS reviewed a draft of the POA. The Assessment Team will develop an ORR Implementation Plan and conduct assessments of Fluor Fernald and RMRS against the plan.</p> <p>In November, Fluor Fernald completed an audit of the RMRS record system and its appropriateness toward successfully completing an ORR. RMRS' record system was found to be satisfactory.</p>
<p>12. Current schedule assumed to be four ten-hour days.</p> <p>"RMRS should evaluate this assumption against FDF productivity factors and experience."</p>	<p>RMRS is using the productivity factors given to them by Fluor Fernald in the Silo 3 Project contract. Additional considerations for efficiencies are being evaluated against the RMRS process.</p>
<p>13. "... early facility design does not appear to lend itself to easy or quick D&amp;D."</p>	<p>RMRS must complete D&amp;D within the schedule, per the contract. This comment has been shared with RMRS.</p>
<p>14. FDF should be sure RMRS is aware of local conditions, restrictions, and requirements that might influence work performance (lift limits due to wind, planning processes before entering contaminated areas, job planning, etc.)</p>	<p>Fluor Fernald has given, and will continue to give, RMRS local site condition information, such as meteorology data, site operating requirements, and local regulatory requirements.</p>

<b>DRAWING COMMENTS</b>	
15. Process Flow Diagrams should identify all relevant input and output streams to each unit operation (including recycle streams) and be related to the mass balance. The sum of inputs and outputs around each unit operation, and the total process should equate.	This comment will be incorporated into the baseline design.
16. Process Flow Diagrams should identify all relevant streams (including recycles) and should be shown on the mass balances.	This comment will be incorporated into the baseline design.
17. Mass Balances should:	
17a. . . . show silos materials on a dry basis	This comment will be incorporated into the baseline design.
17b. . . . show percentage moisture of the silo material, conveyance air, and conveyance air on dry mass flow and volume	This comment will be incorporated into the baseline design.
17c. . . . show the pressure and temperature of each stream	This comment will be incorporated into the baseline design.
17d. . . . show estimated particle loadings and distribution in the conveyance and process air exhaust	This comment will be incorporated into the baseline design.
17e. . . . show the basis for the mass balance calculations (i.e., lbs./hr silo material [dry basis of X weight percentage water]) based on Y hrs./day operation. Also indicate the moisture content of the silo material and the conveying air may vary within certain ranges during operation.	This comment will be incorporated into the baseline design.

18. Removing the large fraction of Silo 3 material that is less than five micron and even submicron in size to protect both the environment and vacuum pumps presents significant challenges. Air cleaning experts with industrial experience should be consulted very early as this issue could significantly impact facility design and operations.	BNFL has hired an HVAC expert to evaluate and resolve air cleaning issues, which will be resolved in the preliminary and final design packages.
19. The pneumatic transport and off-gas treatment systems should operate under a slight vacuum with respect to ambient pressure to prevent contaminating work areas.	This comment will be evaluated during the design process.
<b>Recommendation 10-1:</b> RMRS should expedite the design process based on this report's comments.	See item no. 1 above.
<b>Recommendation 10-2:</b> RMRS should assume that the process facility will need heating and cooling capability.	See item no. 2 above.
<b>Recommendation 10-3:</b> RMRS should conduct mock-up and testing of any complex process equipment, especially remote equipment.	See item no. 6 above.
<b>Recommendation 10-4:</b> RMRS should ensure that it has remote and air cleaning expertise available to assist with the project.	See item no. 7 above.
<b>Recommendation 10-5:</b> RMRS should carefully consider the time that could be required to train personnel to operate the remote arm using only TV monitor viewing.	See item no. 10 above.